REMARKS

Claims 3, 8, 13, 29, 39 and 53 have been canceled, and claims 54 to 57 have been added. Accordingly, claims 1 to 2, 4 to 7, 9 to 12, 14 to 28, 30 to 38, 40 to 52 and 54 to 57 are now pending in the present application.

In view of the following, it is respectfully submitted that all of the presently pending claims are allowable, and reconsideration is respectfully requested.

Applicant thanks the Examiner for considering the previously filed Information Disclosure Statements, PTO-1449 papers and cited reference(s).

Applicant also notes with appreciation the indication of allowable subject matter contained in claims 10, 14 to 20, 36 and 40 to 46. In this regard, each of claims 10, 14, 36 and 40 has been rewritten to include all of the features of its base claim and any intervening claims. Claims 15 to 20 ultimately depend from claim 14, and claims 41 to 46 ultimately depend from claim 40. Accordingly, claims 10, 14 to 20, 36 and 40 to 46 are in condition for immediate allowance. Approval and entry are therefore respectfully requested.

Claim 24 and 50 were rejected under 35 U.S.C. § 112, second paragraph, as indefinite with respect to certain recited features. In this regard, claims 24 and 50 have been rewritten in accordance with the Examiner remarks, and the amendments are believed to be self-explanatory. It is respectfully submitted that claims 24 and 50, as presented, are clear and definite. Accordingly, withdrawal of the indefiniteness rejection of claims is respectfully requested.

Claims 1 to 4, 8, 9, 11, 13, 21, 22, 25 to 31, 35, 37, 39, 47, 48 and 51 to 53 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 7,068,277 ("Menache") in view of pages 166 and 856 of Foley et al., Computer Graphics: Principles and Practice, Addison-Wesley Publishing Company, Inc. 1997 ("Foley").

Claim 1 as presented relates to a system for animating a face, which includes a surface acquisition arrangement for acquiring a set of three-dimensional surface models that approximate a shape of a subject's face in different poses and at successive phases of a particular one of muscle movement and facial expression, the surface models including a base surface model that includes a set of control points which have default position vectors, and for acquiring a set of displacement fields representing motion patterns of the subject's face, such that each displacement field generates a three-dimensional displacement vector that varies over the control points of the base surface model and over an intensity variable, a displacement field derivation unit configured to derive one of the displacement fields from

one of the sequences of surface models by mapping the control points of the base surface model to positions in the surface of each of the surface models in the sequence, and to calculate a displacement of each control point from its mapped position in the first surface model in the sequence to its mapped position in each of the other surface models in the sequence, a storage arrangement for storing the set of surface models and displacement fields, an intensity generator to generate a current intensity value for each displacement field in the set of displacement fields, a deformation unit to combine the displacement vectors generated by the displacement fields at the control points and at the current intensity values with the default position vectors of the control points to generate a deformed surface model, a rendering unit to translate the deformed surface model into a two-dimensional image of the face, and a video output subsystem to at least one of display and store the two-dimensional image.

Similarly, claim 27 relates to a method for animating a face, which includes acquiring a base surface model representing a three-dimensional shape of the face and including a set of control points which have default position vectors, acquiring a set of three-dimensional surface models approximating a shape of a subject's face in different poses, the set including at least one sequence of surface models such that the surface models in a given sequence approximate the shape of the subject's face at successive phases of a particular one of muscle movement and expression, mapping the control points of the base surface model to positions in at least one surface of the other surface models, for each sequence of surface models, calculating a displacement of each control point from its mapped position in the first surface model in the sequence to its mapped position in each of the other surface models in the sequence, to derive a displacement field corresponding to that sequence of surface models, whose displacement field generates a three-dimensional displacement vector that varies over the control points of the base surface model and over an intensity variable, generating a current intensity value for each displacement field, combining the displacement vectors generated by the displacement fields at the control points and at the current intensity values with the default position vectors of the control points to generate a deformed surface model, rendering the deformed surface model to generate a two-dimensional visual image of the face, and displaying or storing the two-dimensional image.

In Menache, displacement controls of the facial model are achieved by overlaying a virtual muscle structure onto the facial model. This virtual muscle structure includes muscle vectors that have specified connections to structures representing skin tissue

and cranial tissue. When a muscle vector is compressed (whether manually by a user or automatically by inference from motion capture data from an actor's face), the facial model "skin" deforms according to the connections of the muscle vector to the vertices of the facial model. The disadvantage of such a system is that the muscle vectors, their connections, and the response properties of the "skin" represent a large body of detail that must be specified by hand, since there is no technology available for acquiring such data from direct measurements applied to an actor's face. Indeed, Menache does not refer at all as to how the virtual muscle structure may be developed from measurements. Likewise, the Foley reference provides no further information or suggestion in this regard.

According to the presently claimed subject matter of claims 1 and 27, by contrast, the displacement controls of the facial model are designed without overlaying such a virtual muscle structure. Instead, the controls are displacement fields derived from the differences between surface models that are acquired from the subject's face by surface measurement. Each displacement field is derived from a sequence of surface models approximating the shape of the subject's face at successive phases of a particular muscle movement or expression. Thus, displacement fields are determined by sets of surface measurements without the use of an overlaid anatomical model.

Accordingly, for at least these reasons, the combination of the Menache and Foley references does render claims 1 or 27 as presented obvious, and therefore claims 1 and 27 as presented are allowable.

Claims 2, 4, 9, 11, 21, 22, 25 and 26 ultimately depend from claim 1, and are therefore allowable for at least the same reasons as claim 1, as presented.

Claims 28, 30, 31, 35, 37, 47, 48, 51 and 52 ultimately depend from claim 27, and are therefore allowable for at least the same reasons as claim 27, as presented.

In view of all of the foregoing, withdrawal of the obviousness rejections of these claims is respectfully requested.

In further regards to the rejections of these claims, it is respectfully submitted that Applicant does not necessarily agree with Office Notice remarks appearing pages 4 to 6 of the Office Action.

Claims 5 to 7 and 32 to 34 were rejected under 35 U.S.C. 103(a) as unpatentable over Menache and Foley in view of Y.F. Wang and J.K. Aggarwal, An Overview of Geometric Modeling Using Active Sensing, IEEE Control Systems Magazine, Vol. 8, No. 3 ("Wang").

Claims 5 to 7 ultimately depend from claim 1, and claims 32 to 34 ultimately depend from claim 27, and therefore these claims are allowable for essentially the same reasons explained above, since the third-level Wang reference does not cure the critical deficiencies of the primary references.

Claims 12 and 38 were rejected under 35 U.S.C. 103(a) as unpatentable over Menache and Foley in view of G.Turk and M. Levoy, Zippered Polygon Meshes from Range Images, Computer Graphics Proceedings, ACM SIGGRAPH 1994 ("Turk").

Claim 12 ultimately depends from claim 1, and claim 38 ultimately depends from claim 27, and therefore these claims are allowable for essentially the same reasons explained above, since the third-level Turk reference does not cure the critical deficiencies of the primary references.

Claims 23 and 49 were rejected under 35 U.S.C. 103(a) as unpatentable over Menache and Foley in view of U.S. Patent No. 4,092,493 ("Rabiner").

Claim 23 ultimately depends from claim 1, and claim 49 ultimately depends from claim 27, and therefore these claims are allowable for essentially the same reasons explained above, since the third-level Rabiner reference does not cure the critical deficiencies of the primary references.

In view of the foregoing, withdrawal of the obviousness rejections is respectfully requested.

New claims 54 to 57 have been added herein, the features of which correspond, respectively, to the features of canceled claims 10, 14, 36 and 40. Accordingly, new claims 54 to 57 do not add any new matter, and are supported by the present application, including the specification.

Moreover, claims 54 to 57 depend, either directly or indirectly, from claims 1 or 27, and are therefore allowable for at least the same reasons as claims 1 and 27.

Entry and approval of new claims 54 to 57 is therefore respectfully requested.

In sum, claims 1 to 2, 4 to 7, 9 to 12, 14 to 28, 30 to 38, 40 to 51 and 54 to 57 are allowable.

Conclusion

In view of the foregoing, it is respectfully submitted that all of the presently pending are allowable. It is therefore respectfully requested that the objections and rejections be withdrawn. All issues raised by the Examiner have been addressed, so that an early and favorable action on the merits is respectfully requested.

Respectfully submitted,

Dated: _1/10/07_

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